Energy & Environmental Research Center
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October 29, 2021

Ms. Karlene Fine
Executive Director
North Dakota Industrial Commission
600 East Boulevard Avenue, Department 405
State Capitol, 14th Floor
Bismarck, ND 58505-0840

Dear Ms. Fine:

Subject: Quarterly Status Report for the Period of August 1 – September 30, 2021, "Field Study to Determine the Feasibility of Developing Salt Caverns for Hydrocarbon Storage in Western North Dakota"; Contract No. G-054-104

Attached please find the Energy & Environmental Research Center (EERC) Quarterly Status Report for the subject project. If you have any questions, please contact me by phone at (701) 777-5181 or by e-mail at ssmith@undeerc.org.

Sincerely,

DocuSigned by:
Steve Smith
92138D2CF98E498...
Steven A. Smith
Principal Geologist, Integrated Analytical Solutions

SAS/kal

Attachment

FIELD STUDY TO DETERMINE THE FEASIBILITY OF DEVELOPING SALT CAVERNS FOR HYDROCARBON STORAGE IN WESTERN NORTH DAKOTA

Quarterly Project Status Report

(for the period August 1 – September 30, 2021)

Prepared for:

Karlene Fine

North Dakota Industrial Commission
600 East Boulevard Avenue, Department 405
State Capitol, 14th Floor
Bismarck, ND 58505-0840

Contract No. G-054-104

Prepared by:

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Stacy J. Kouba

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October 2021

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EXECUTIVE SUMMARY

The Energy & Environmental Research Center (EERC) was awarded a contract by the North Dakota Industrial Commission (NDIC) Oil and Gas Research Program (OGRP), NDIC No. G-054-104, to conduct a study on the feasibility of developing salt caverns in geologic formations in North Dakota for underground storage of energy resources, including natural gas, liquified natural gas, and hydrogen, as directed by Section 14 of North Dakota Senate Bill 2014. The EERC, in partnership with Bakken Energy, Neset Consulting Services (Neset), and the University of North Dakota (UND) Department of Petroleum Engineering, will validate the suitability of salt formations for cavern development and provide stakeholders with information needed to assess the techno-economic viability of storing hydrocarbons and hydrogen in engineered salt caverns in North Dakota. This update is for August 1 through September 30, 2021.

Although the contract agreement was received on October 26, 2021, work was performed during the preaward phase beginning in August 2021. The project kickoff meeting was held on September 9, 2021. Prospective advisory board members were identified, and discussions took place to invite them to join the board. Nondisclosure agreements were executed between project partners and advisors to discuss salt cavern opportunities, site selection, and detailed drilling and coring operations.

Geologic screening of North Dakota salt formations began during this reporting period and will be used to identify potential sites for drilling a stratigraphic test well. Eight cross sections of North Dakota salts were created using publicly available well logs. The cross sections were evaluated for salt formation thickness and depth, and four target areas were identified for drilling. Discussions with project partners are planned and will identify the sites with the highest likelihood for successfully encountering thick accumulations of subsurface salt.

FIELD STUDY TO DETERMINE THE FEASIBILITY OF DEVELOPING SALT CAVERNS FOR HYDROCARBON STORAGE IN WESTERN NORTH DAKOTA

INTRODUCTION

The Energy & Environmental Research Center (EERC) was awarded a contract by the North Dakota Industrial Commission (NDIC) Oil and Gas Research Program (OGRP), NDIC No. G-054-104, to conduct a study of the feasibility of developing salt caverns in geologic formations in North Dakota for underground storage of energy resources, including natural gas, liquified natural gas, and hydrogen, as directed by Section 14 of North Dakota Senate Bill 2014. The EERC, in partnership with Bakken Energy, Neset Consulting Services (Neset), and the University of North Dakota (UND) Department of Petroleum Engineering, will validate the suitability of salt formations for cavern development and provide stakeholders with information needed to assess the techno-economic viability of storing hydrocarbons and hydrogen in engineered salt caverns in North Dakota.

This study follows a preliminary evaluation of the potential of salt cavern development completed by the EERC in December 2020. The 2020 study identified three salt formations deemed worthy of further investigation for characterization activities to inform future cavern development studies.

The goal of this field study is to validate the depth, thickness, and geologic and geomechanical suitability of the North Dakota salt formations for salt cavern development. The anticipated outcome is key information, needed by the state, the oil and gas industry, and other interested parties, to assess the techno-economic viability of storing hydrocarbon gases and hydrogen in engineered salt caverns.

This project will incorporate field, laboratory, modeling/simulation, and engineering analysis and design to determine the potential for salt cavern development in North Dakota. The work will be conducted in seven tasks.

ACCOMPLISHMENTS DURING REPORTING PERIOD

Project Management

This task includes the necessary activities to direct the project to meet all technical, schedule, and budget requirements. Work under this task will ensure that project plans, results, and decisions are appropriately documented and project reporting and briefing requirements are satisfied.

Significant accomplishments during the reporting period include the following:

- Although the contract agreement with NDIC was received on October 26, 2021, work was completed during the preaward phase. The project kickoff meeting was held on

September 9, 2021. The project goal, objectives, scope of work, deliverables, timeline, and project resources were reviewed with the EERC and UND Petroleum Engineering teams.

- Regularly scheduled update meetings began on September 20, 2021, to discuss progress on the project.

- Nondisclosure agreements (NDAs) were executed with project partners and industry advisors to discuss sites and salt cavern opportunities.

- Discussions occurred with all potential Industry Advisory Board members. At present, Lonquist, Pivotal, ATCO, ONEOK, Mitsubishi Power, and Lane have agreed to participate.

Site Screening and Characterization

In this task, potential locations with amenable salt formations will be identified and targeted for screening and characterization. Screening criteria will be based on the interpretation of publicly available wireline logs, thickness, confinement, and depth. Several potential site locations will be identified, and some small-scale, localized geologic modeling will be performed to inform decision making.

Significant accomplishments during this reporting period include the following:

- Eight geologic cross sections were prepared to screen for Dunham, Pine, Opeche, and Charles salt formations using 61 wells across the Williston Basin.

- Four areas were targeted for potential drilling. Work has begun to refine the understanding of the geology around the targeted areas.

Site Selection/Land Permitting

In this task, the potential project locations identified in the Site Screening and Characterization task will be evaluated with project partners. Bakken Energy will secure the land options and surface and subsurface rights in close collaboration with the EERC. Permits will be secured in preparation for drilling.

Significant accomplishments during this reporting period include the following:

- Initial planning and discussions with Bakken Energy have been ongoing during the preaward phase, with the goal of expediting the site-selection process and advising on optimal surface site locations for drilling.

Drilling and Core Collection

As part of this task, a stratigraphic test well will be drilled at the selected site. The well will be logged, and core will be collected through the target salt formations. Neset will provide general contracting services and will work closely with the EERC throughout the process from planning to site closure.

Significant accomplishments during this reporting period include the following:

- EERC personnel traveled to Tioga, North Dakota, to meet with Neset representatives. The purpose of the meeting was to develop preliminary well design plans for the stratigraphic test well.

- A drill rig with availability in Quarter (Q) 1 2022 was identified.

Core Testing and Interpretation

This task includes all the core testing and interpretation. Tests will be performed to identify bulk characteristics of the formation, including lithology, thickness, porosity, permeability, mineralogy, geomechanical competency of the overlying and underlying sealing formations, geomechanical properties of the salts, and dissolution properties of the salts.

Significant accomplishments during this reporting period include the following:

- No progress to report during this reporting period.

Geologic and Geomechanical Modeling

As part of this task, modeling will be performed based on site-specific data generated through the drilling and core testing. Geologic models will be developed to inform the subsurface geologic regime and evaluate the regional structural and stratigraphic trends. Geomechanical modeling will incorporate information derived from the geologic models and the site-specific data and will inform the overall cavern dimensions and operational stability. Significant accomplishments during this reporting period include the following:

- No progress to report during this reporting period.

Engineering Analysis and Design

This task includes the detailed engineering design and analysis that will be performed to identify surface equipment needs; design specifications; brine handling, use, and disposal practices; and monitoring needs. The EERC will also seek advisement from external engineering teams with expertise in developing and operating salt caverns used for hydrocarbon storage. Site-specific implementation plans for future cavern development will be created.

Significant accomplishments during this reporting period include the following:

- No progress to report during this reporting period.

FINANCIAL INFORMATION

This study is sponsored by NDIC OGRP with in-kind cost share provided by Bakken Energy. Table 1 presents the expected budget and expenses to date for the study.

Table 1. Salt Cavern Study – Expected Budget and Expenses to Date

Sponsors	Expected Budget	Actual Expenses as of 9/30/2021	Balance
NDIC Share – Cash	$9,500,000	$9,071	$9,490,929
Bakken Energy – In-Kind	$500,000	$0	$500,000
Total	$10,000,000	$9,071	**$9,990,929**

PLANNED FUTURE ACTIVITIES

The following activities are planned for the next quarter.

Project Management

- Contract with Neset.
- Send letters to the prospective advisory board members.
- Continue regularly scheduled update meetings.

Site Screening and Characterization

- Evaluate geologic cross sections and identify potential sites for drilling.

Site Selection/Land Permitting

- Select a site for drilling.
- Secure land agreements and permits for drilling.

Drilling and Core Collection

- Complete well design.
- Identify core and log data needs.

Core Testing and Interpretation

- No progress is anticipated on this task during the next reporting period. The planned start for this task is June 2022.

Geologic and Geomechanical Modeling

- The modeling teams will assist with site characterization and will provide input on site selection, well logging needs, and core collection needs.

Engineering Analysis and Design

- Work will begin on the engineering analysis.